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AUTHOR Hertlein, Grace C.
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ABSTRACT

The developmental background and rationale are given for an introductory course in computers. Using computer art as the vehicle for instruction, this course is designed for people in disciplines other than computer science. The 16-week course syllabus described contains a weekly lecture, laboratory activities, assignments, and final exams. Several tested approaches which have led to the course's success in the past include (1) thinking about computers in English, (2) using canned programs which students learn to use and adapt for their own purposes, (3) using debugging techniques different from the traditional methods, (4) using a varied menu approach in each lab session, and (5) stressing group learning, helping, and working. (CMV)

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COMPUTER ART-- A NEW COURSE OFFERING FOR GENERAL EDUCATION

BY

Grace C. Hertlein

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Computer Art — A New Course Offering for General Education

Grace C. Hertlein
Department of Computer Science
California State University, Chico
Chico, California 95929
(916) 895-6443

Background

During the past seven years, California State University, Chico, has offered a variety of beginning and intermediate courses in computer art for programmers, non-programmers, and for artists. This course derives its substance from the experience of working with hundreds of students from many disciplines, from many class levels.

An early paper, *The Artist and Computer Art*, from CCUC/3, 1972,[1] described an approach for artists. That material (and the other courses in computer art) has been drastically revised. However, in working with so many students, and obtaining good feedback from them, specific modules of instruction have been identified as useful, sufficiently good to retain, and these have been incorporated into the present course.

It is hoped that this definitive syllabus, with week-by-week lecture/discussion topics, together with laboratory experiences and assignments, will be a useful body of material for people who desire to implement a humanities-oriented computer course. Suggestions and ideas from the readers are welcomed by the author, and this material will become part of future planning for Computer Art for General Education.

Attitudinal Changes Regarding Papers and Articles

During the past years, the author has engaged increasingly in writing and editing. Certain personal attitudinal changes regarding papers and articles have been noted as a strong personal change: going away from self-expression to consideration and communication of "useful" material for the reader. This means going beyond enticing "generalities" and beyond lists of materials used, to impart more material in one paper. This is particularly useful for many people, in that it eliminates a great deal of correspondence, trying to get more information from an author, stemming from an original paper. However, this method does depart from the traditional conference papers which appear to "lightly touch" on a subject, rather than developing the material in depth.

Development of the General Education Course

The present syllabus arose from experimentation with other computer art courses, but more, from communication with the curriculum committee of the Department of Computer Science. The need became evident, to alter and greatly revise the upper division computer art course for computer science majors and minors, and to make that offering a technically oriented, practical offering. A description of this course, and a week-by-week syllabus is given in a paper submitted to SIGGRAPH 77, titled *Computer Art for Computer People—A Syllabus.*

Since the latter course and the present offering both are exposure courses for different kinds of people, there are related materials in both syllabi.

This class-tested offering is aimed at the freshman/sophomore student for general education credit. However, it is often taken

by juniors, seniors, and even graduate students, people from many disciplines other than *computer science*. It may be taken by non-computer science majors and minors for lower division elective credit on a plus/minus (credit/no credit) basis.

Rationale for the General Education/Art Development

A discerning reader will discover elements of the CCUC/6 paper on *The Microfilm Plotter and Computer Art*, from 1975.[2] There are also elements of a "Computers and Society" course, and from an "Introduction to Computers." Reference is made to the CCUC/5 paper, *Computers, Society, and Man*.[3]

What is the rationale for this combination of what is literally an "introduction" to computers, using computer art as the vehicle for instruction? Here are some answers:

1. Many institutions have courses titled "Computers and Society" and "Introduction to Computers." Too often the introduction courses evidence a traditional machine orientation, and allow limited computer use. The latter courses do not fulfill the liberal, interdisciplinary requirements for general education people. For technical people, these courses are superior, and are a prerequisite to further computer science offerings. The society courses have limited computer experience opportunities, because they are reading/discussion courses. Both these course offerings have valuable contributions to make in the undergraduate curriculum. More organizations (including ACM) are openly recommending a computer exposure course for every student, to prepare that person for living in a computer age.[4] This syllabus provides for such a generous computer exposure.

2. People who desire to use the computer for interdisciplinary, humanistic purposes require a special course tailored to their more general interests. The standard FORTRAN courses are too difficult for most interdisciplinary students. Further, they are not interested in a computer printout as a final product of their study. Additionally, these courses do not provide for the degree of personal expression, and the refinement of this expression, during a one-semester course. This tested syllabus affords personal expression and within its structure, has innumerable opportunities for personal decision-making and choices. It enhances decision-making capacities.

3. Graphics courses have a broader appeal for more kinds of people, from many levels. In a recent paper, Kai Chu remarks of results from traditional approaches, ". . . I found that they were *not listening*,"[5] and contrasted the marked improvement in motivation, learning, and accomplishments when graphics were introduced.

The writings of Al Bork[6] repeatedly reveal the "power of graphics" to enhance learning and understanding.

In summary, a graphics-oriented computer course is a more powerful tool for learning. We are a picture-oriented, visual species, and we have been for thousands of years. Perhaps the strongest contribution of such a course is that people learn something about the computer by "doing." An experience course offers far more opportunities to understand and know, from John Dewey's idea of "learning by doing." Reading courses do not afford such experiences.

The Approach

The approach used in this general education course is markedly different from the technically-oriented offering in which everything is presented in a technical manner. Although there is much analysis, problem-solving, and decision-making in this course, the method of presentation is informal, natural. Here are a few approaches tested in this syllabus:

1. *Thinking About Computers in English.* People in any given discipline tend to "speak in tongues," not understandable by the uninitiated. "Computereese" is a form of precise communication that regular people find difficult to understand. Faculty from computer science do not communicate in

English either, as evidenced by the comments of students. Gradually, the concepts of trying to think and talk about computers in English arose. In this course, students try to think about programming in English before programming, to understand in plain English, what is being required of the computer. It is easier to teach people to be more precise in English (or their natural tongue) than it is to teach them programming. To become more precise in speech and writing enhances communication between people, allows one to problem solve (and program) more readily.

2. *Canned Programs Used, Along with a Graphics Subroutine Library.* Students learn to use programs and plan personal variations, but they do not write totally new computer programs. Emphasis is on use, understanding. At first, canned duplicated decks are utilized, so that keypunching is at a minumum. After a few weeks, students are able to keypunch fairly well, and they can make changes easily. They are able to SYSCOPY their own decks and materials independently, and the transition is not difficult. Canned routines from the graphics library are used, and students merely pass parameters to attain personal variations. Details of this system are described in the week-by-week syllabus.

3. *Debugging Techniques Depart from Traditional Programming Classes.* Since canned routines are used, errors can be found more easily. Students are encouraged not to spend an excessive amount of time ferreting out errors, and after a reasonable amount of work in debugging, they may ask for special help. They are, however, encouraged and required to aim at independence. We have experimented in debugging via telephone, when the instructor is off campus, and writing at home. This works very well. Should this system fail, students will ride their bicycles to the instructor's home for a quick debugging session. The group learns far more than succeeding, going ahead, than from traditional debug methods.

4. *A Varied Menu Approach is Presented in Each Laboratory Session.* More is learned from presentation of varied materials within a single laboratory session. This is particularly true when the lecture hour is followed immediately by a two-hour laboratory period, making a three-hour class. During the last year, as an experiment, one group was assigned a lecture period followed by a two-hour lab, followed by a two-hour break, and a second two-hour lab, making a total of five instructional hours with the same students in one day. This was demanding for both students and the instructor, but it was highly successful, due to the intensity of the instruction, and the students found it stimulating, because of the variety of materials presented in one day. If participants followed the one day of instruction by obtaining special help during office hours (or via the phone), it worked remarkably well.

In an interdisciplinary class, presentation of varied materials is necessary. Further, such presentation avoids boredom.

5. *A Very Structured Approach is Used.* Coming from the humanities, the author has had a tendency to present materials in an open-ended flexible manner. However, experience repeatedly revealed that the fast students did very well, but those not in this category neither learned nor produced as well. Repeated feedback from students has urged a tight structure, with specific materials and assignments, and a faster pace. Whether we like (to admit it) or not, in many undergraduate institutions at present, students respond far more when pushed at least moderately. The progressive Montessori-like methods do not work at this level, for people will work harder for the firm, structured instructor. This was a great disappointment for the author to recognize this. However, a teacher's job is to "take people where they are," and then to take them beyond that point. The structured approach that provides for areas of freedom, does provide for growth and for self-expression. Students experience self-discipline.

6. *Parallel Processing of Information is Required.* This poses some difficulties for many students, for they are not accustomed to receiving, in one class period, input from diverse disciplines in one package. Perhaps in

the near future, when interdisciplinary studies have become a reality rather than an oddity, presentations of related (but dissimilar) materials will be more readily assimilated, because of student adaptation. The skill of considering several ideas simultaneously, and working this material into a synthesis is a practical, valuable development, regardless of discipline.

7. *A Group Approach of Learning, Working, and Helping is Stressed.* Education of the future will depart drastically from present approaches in use today. Content will not be the only change, nor reliance upon technological systems. Interdependent with content and use of technological systems is a need to develop human-relations skills that are satisfying and viable. The people in a class are at least as important as the subject, and the relationships between students in a class have been sorely neglected in many disciplines. There is a need to supplant individual competition with cooperation and communication on a person to person basis, and this can be translated as an educational experience on a student-to-student basis. With this frame of reference, students talk to each other, give each other suggestions. Using the group approach, they encourage each other, and literally teach each other. Carl Rogers' "unconditional positive regard" is the setting for this environment of person to person learning. *There is far more learned by every person in such a class.*

Summary

A review of the definitive week-by-week syllabus should be helpful to faculty who desire to begin a lower-division computer-oriented humanities course. There are advantages in using a tested syllabus, particularly using materials tested over a period of time. By definition of an interrelated structure for the entire semester, more is accomplished and gained, because of the alternatives that have been sifted, and the continuity of the retained material. One activity or topic leads to another related exploration.

It would be naive to assume that another institution would adopt the material in total. The tested material provides sufficient information for individual faculty adaptation, incorporating personal materials, and is presented in the hope that it will be useful to others.

Week I

Lecture:

Slides of computer art are shown. Emphasis is placed on enjoyment of the many varieties of personal expression. National, international, student works are shown and informally reviewed by the instructor. The newest trends and ideas are very briefly related. Concept: The computer is an aid in creation, a colleague, not a protagonist. People of many types are able to use the computer to create personal art, and many of them would not be able to achieve the level of their art without a computer. Computer art is a new form of art that integrates science and art.

Laboratory:

1. Review of the syllabus, course requirements, etc., are thoroughly discussed by the group and the instructor. Identifying the tone of the class, as a group, with cooperation and open questioning replacing competition. Becoming acquainted with the group, working individually and as a group is emphasized.

2. Introduction to designing, using a continuous line design, or a design made up of two continuous line designs. Brief review of types of continuous line designs using slides, and their development by other artists and students. Brief introduction to design derivation techniques, to achieve half a dozen alternatives before listing the coordinates for the first, quick design.[8]

3. Introduction to cartesian coordinate system and pen values. Listing in an array the latter values. Checking each student to see that he understands the system. NOTE: In order to accomplish this, the design should not be in great detail—it is merely a step to begin using the system, to begin working with the computer.

4. Introduction to job control language in very simple English terminology, explanation of ways to punch cards in fixed format on data cards. Use of duplicated programs, so students will have very little keypunching to do in these first few weeks. Students type coordinates and pen values and input programs into the computer.

Assignments:

1. Study the inventory sheet of computer reactions handed out at the end of the last lab session, and think over personal ideas about the computer. Bring to next class session for discussion and review.

2. Collect pictures of art works from varied sources that have a strong personal appeal. Use photographs, Xerox copies, magazine and newspaper illustrations, advertisements, etc. Use in the second laboratory period.

3. Proof the first design on the computer semantically, then write a magnetic tape, and bring to class for the first lab session. Demonstration of the graphics system will allow students to proof designs on the cathode ray tube and on two sequential plotters.

4. Recall types of computer art that had a strong personal appeal. Art checksheets will carry this analysis further next week.

Week II

Lecture:

Informal history of the varied computer arts: art graphics; designs for textiles; automated-executed weaving; choreography; computer-generated compositions and computer-executed music; computer-designed sculpture and paintings, etc. The prehistory of computer art is reviewed—mathematics and science in art, particularly in the early 1900's, and in the Bauhaus. Examples of the latter as illustrations of the art science movement as a natural prelude to computer art. Changes in the types of participants, and the newest tendencies in computer art.[9] The future of the computer arts.

Laboratory:

1. Art checksheets, and a very brief perusal of the types of art, their sources, ways of programming and development. Using the checksheet to chart first reactions to this new medium. Date the checksheet, so sequential notes (in a second color) can be noted, as preferences change from exposure and experiences. Note reasons for preferences—beginning experiences in verbalization. List reasons on the back of the forms.

2. Review of inventory sheet of computer reactions: (a) What is a computer? (b) How does it work? (c) What can it do? (d) What can it not do? (e) The future of computers and man? (f) Processing vs. thinking on the part of man and computers? NOTE: This inventory sheet is deliberately used before seeing a film on computers, and the same sheet will be used again during the semester several times. Introduction to subjective, objective thinking processes, analysis. Discussion of reasons for reactions, and study of what types of thinking are involved, i.e., are ideas about computers based on non-exposure, fear, movies, etc.?

3. Film, "The Digital Computer" by the U.S. Navy. Review of the film, explaining in English computer terms, along with developing a computer vocabulary. Discussion of how a computer works, and its logical processes, along with its speed. Computer errors, and examples of their occurrence, reasons for, etc. Computer art is an artistic problem, in which decision-making occurs. Making out a class schedule is another form of problem, and decision-making takes place. Becoming conscious of problems, decision-making, solutions.

4. Introduction to a new subroutine, Factorit, a decrementing routine on the computer graphics library. Contrasting a subroutine with a program. Reviewing the subroutine, to note differences. Class brainstorming about innumerable ways to vary the first module, noting these in pencil on graph paper, then choosing from alternatives. Noting that this is another example of decision-making. The need to search for alternatives before making decisions is em-

phasized. Using the new subroutine in a new program.

Assignments:

1. Rewrite the inventory sheet of computer reactions in a composition.
2. Proof and run the second program on the plotter or CRT.
3. Assemble a three-ring binder with tabs for varied notes and ideas.

Week III

Lecture:

Design derivation from varied sources: the environment, nature, man's mind, science, art, etc. Meaning of derivation, from a source. The need to recognize that ideas are input from sources and processed by man. Illustrations of student sketches, derivation exercises, along with work of Mondrian are presented via black and white slides. Demonstrating very briefly the system used (see 8), with experience this week by using the exercise system in lecture and in lab.

Laboratory:

1. Library research, in which students study graphics, and/or subject material of their choice, based on the illustrations brought to class. Exploration of opposites is briefly introduced: identifying what is not liked, what is pleasing, and noting degree of unattractiveness. Recognition that forms and patterns, sources are subjective preferences, and that no one form is better than another, although in art, there are fashions of forms and development. Instructor assistance in Library.
2. Design derivation exercises, executing the technique described above, in the NCC '77 paper. Addition and subtraction to input forms is accomplished. Learning to create quickly, spontaneously as a game. Learning to create without fears or inhibitions—just to do it, naturally. Very brief questions on creativity.
3. Introduction to subroutine Restore, a routine that allows the manipulated component (that was decremented towards a point) to be restored (original values called again), and decrementation towards a second or third origin may be achieved. Again, the game-like attitude, brainstorming about alternatives. Using a canned, duplicated program, keypunch up the very few cards needed to use this program. List the program for errors, and input into the computer. Proof graphically outside of class, for next week. (All routines are from the FORTRAN IV Art Manual.)[10]
4. Verbal sharing of rewritten ideas about computers. Note differences of opinions. Divide class into two groups. Briefly, spontaneously debate on pros and cons of computers from a list of topics quickly made up by students relating to the assignment. Then switch sides, giving opposite opinions. See how many ideas, both pro and con can be logically and/or subjectively mustered for debate.

Assignments:

1. Correct Program II, using Factorit or Restore, so that it is correct and attractive, to begin experimenting with art papers during Week IV. Begin to think of personal choices in colors.
2. Conclude design derivation exercises, so a new design (II) will be programmed and developed in class in laboratory session.
3. Mark design derivation sketches with preferences, and note in English, reasons for preferences. Note opposites, disliked sketches, analyzing reasons for such reactions.

Week IV

Lecture:

Introduction to color, art materials, using student works, and works by other artists (actual graphics, textiles, etc.). Effects of color, color values, variant pen thicknesses, etc. Review of the color wheel, primary, secondary, tertiary colors, etc. Effects of analogous colors, and complementary colors, and how they may be used. Handout on

material development, contemporary, traditional effects, etc. and hov they are attained. Demonstration of color exercises is given.

Laboratory:

1. Demonstration of colors, using diverse colored papers, and how to attach them to the drum plotter, how to change pens, etc. Developing several finished graphics in color from student works. Analysing, when is a work finished vs. the exercise, and noting individual preferences regarding simplicity vs. complexity and gradations in-between.

2. Introduction to a random routine, Rfacput, that allows pseudorandomization of initial and last placement design component on the X and Y, along with minimum/maximum sizes desired, and number of modules to be placed on the paper. Looking at a few examples of work that contain randomizations.

3. Using planning sheets to achieve many alternatives by changing parameters before programming. Exploring opposites, large, small works; complex, simple works, etc., attained by planning before programming. Using the new routine, again with a duplicated deck, and keypunching two or three cards to achieve a personal work. Inputting the program into the computer. Introduction to piggybacking programs, so that many may be run sequentially on the magnetic tapes.

4. Learning to think about programs in English is begun and continued throughout the semester. (People who work consistently with computers talk in "computereese," which the uninitiated cannot understand.) Expressing the more precise English, what goes on in a program, so that students can begin to write program statements in English to be able to debug their programs more readily, and to understand what they are instructing a computer to do. Development of computer vocabulary: fields, arrays dimension statements, a program, a subroutine, do loops, job control language, etc.

Assignments:

1. Using a brief demonstration in color exercises, students complete three pages of simple, identical drawings with twelve colored felt pens. Note color preferences, dislikes, and reasons for same.

2. Run a graphic on art paper before next week, and bring to class for review and sharing. Use preferred colors of paper and pens.

3. Debug new random program, and run on industrial paper (or art paper if it is pleasing).

4. Make notes in English on ditto sheet of new sample programs, and discuss during Week V.

Week V

Lecture:

Creativity, inventivity, using in laboratory a film, and notes from Hertlein,[11], Mueller,[12] Rothbart,[13] etc. Manipulation vs. creativity, along with a search for more precise definitions of creation, assemblage, execution, rearrangement, synthesis, etc. Deliberate brief exploration of ideas before seeing film, to note differences in film. Citing innumerable areas of life wherein one may be "creative, inventive."

Laboratory:

1. "Why Man Creates" is shown. This excellent film by Bass, in movements, in which specific ideas are explored. After showing of the film, explore specific ideas in each movement of the film, and discuss the essence of each portion. Relate creativity, inventivity in science to art, and contrast Einstein's statements, Edison's, Hemingway's, etc. Can creativity be assisted by the subconscious? Are creativity and inventivity "brute force" activities? Can the computer be creative, inventive?

2. Handouts, "Are You Thinking Machines?" by Arthur C. Clarke, and Turing's brief essay on the subject.[14] Brief overview of ideas in the two essays. Identifying what is meant by the term, "to think." Search for definitions. Comparisons of ideas between processing and "thinking." The role of the subconscious, synthesis, with excerpts from several sources, with discussion by the group on this area.

3. Introduction to Mirror, a graphics library subroutine. Use of the latter, to achieve new variations of previous programs using the decrementing and random routines. New programs are written, and keypunched (using canned decks), so that comparisons can be made with the first Factorit and Rfactput programs without Mirror, and those with reflected forms.

4. Open lab period for extra help, and fuller development of material presented and assigned.

Assignments:

1. Read thoroughly the two articles briefly reviewed in class. Write a three page paper on the topic. Review the paper, and edit it, labeling subjective, objective areas, and rearrange the material. Look for underdeveloped areas, and overdeveloped material. Prune if necessary. Hand both papers in for discussion and review during Week VI. Integrate materials, ideas presented during Week V.

2. Program Design II with Factorit, Mirror and Restore. Then do another program (using canned decks) for Rfactput, Mirror and Restore. Proof on industrial paper before next laboratory, and if artistic, run on art papers with colored felt pens.

3. Maintain notebook, adding new ideas from outside readings, class material, and new insights gained from discussions.

4. Choose a related, third design from sketches, to program during Week VII.

Week VI

Lecture:

Computers in the humanities, their origins, present state of the art, with brief examples of music, slides of sculpture, illustrations from art exhibition catalogs, actual works, printouts of choreography, etc. The "humanities" in some instances include art, anthropology, archaeology, English, history, music, philosophy, religious studies, speech, drama, dance, etc. (There are differences in various institutions.) Review the handout, a listing of papers on computers and the humanities from a recent international conference.

Laboratory:

1. Discussion, integration of above ideas with student writing on thinking machines, the role of man, etc. Identify main ideas occurring repeatedly in student reactions and compositions, and list these. Students are to repeatedly note down and maintain a file of specific, personal reactions to discussions, films, etc. Excerpts from Sheldon Klein, automatic novel writing,[15] and Russian Folk Fairy Tales,[16] from recent international conferences.

2. The exercise vs. the finished graphic—studying works executed thus far. Responding as a group (and individually) to graphics, and verbalizing regarding color choices, positive and negative areas, dominant and subordinate elements of composition, etc. Noting on art checksheets in a second color, any changes in preferences and working habits at the present. When is a work finished? What are some principles of art that are used in computer art? Is art purely subjective: "I don't know much about art, but I know what I like" idea is banished. Trying to become more verbal, more precise in statements about art, and in other areas, and in communicating more.

3. Finding a personal direction through analysis of all work accomplished thus far. What are finished works? What graphics express personal ideas that are pleasing? What are the reasons for pleasure or subjective displeasure? Planning to revise all unsatisfactory work, with special help to program changes, revisions. Use of planning sheets to assist in revisions, and learning independently to revise programs, going beyond instructor's help.

4. Open lab period to reprogram needed changes resulting from above discussions and planning.

Assignments:

1. Make a portfolio to contain all flat art work. Have brief notes regarding preferences and development of all material.

2. Revise all graphics programmatically, so that finished art paper graphics result from revisions. All work should reflect a personal

direction (although that direction may be freely explored and changed during the semester).

3. Have all work up to date, to begin new programs next week, with a new design.

Week VII

Lecture:

Interdisciplinary graphics, how graphics are used in other disciplines. Slides, illustrations, overhead transparencies are shown, with a presentation of graphics applications for innumerable purposes: oceanography, computer-aided design of automobiles, airplanes, ships, architecture, city planning, engineering, etc. A very brief overview of the systems that afford interdisciplinary graphics.

Laboratory:

1. Discussion, how are computers (and graphics) used in my major discipline? What is the potential of the computer in the student's career objective? How are computers and graphics being utilized at the present time in these areas? Motivation is given for research in this area, and a minor research paper to be undertaken within the next few weeks.

2. Program Design III, and duplicate personally any programs to be used via SYSCOPY, so that minimal keypunch occurs. Use of planning sheets to attain new variations. Since students are acquainted with a decrementing routine, a restoration of values subroutine, a mirror, and a random routine, they possess the ability to quickly program other designs, referencing known subroutines. New work should deviate from previous work, in that it allows a broadening direction. This is attained by planning sheets.

3. Library research on computer/graphics applications, with individual help from Reference Library Readings, and student desires for topical material. Suggestions from instructor, once student has identified the specific aspects of research in the major area of study. Finding periodicals and texts that are of suitable level during the reference period.

4. Open lab period to begin and complete planning and some programming of Design III.

Assignments:

1. Continue library research, and make note of references to be used. Make sure they are not too elementary nor advanced for mental stimulation.

2. Program Design III in at least two new ways, using different subroutines, and using other needed routines (as Mirror and Restore). The new graphics should depart from previous work, representing an exploration. For example, if the student has been working in a complex linear pattern, the new graphics may explore less complexity, and vice versa. Another example: if previous work is closed, without open spaces (void areas), new work should explore open areas of positive and negative spaces.

3. Graphically proof new work on industrial paper for Week VIII. Compare new works with previous graphics and note results, and preferences, along with reasons for success or lack of success.

Week VIII—Midterm

Lecture:

Special showing of ruby laser graphics and computer music. As a break from midterm requirements, varied forms of computer-aided/executed music are played, with a laser set-up that affords red, moving graphics resulting from vibrations of the music. A brief review is given of different ways to use the computer in music, and also a description of how the laser graphics are achieved. Graphics are shown in a darkened room, with computer music audio.

Laboratory:

1. Guest speaker discusses lasers and their applications, and laser/computer uses in diverse disciplines. Question and answer period allows development of the subject.

2. Midterm self-evaluation form is given and completed, along with student input regarding revisions and changes for the course, with reasons for same.

3. Matting demonstration, with students learning to measure, cut mats with a beveled mat-cutter. Preparation of work for the portfolio, with special help.

4. Revisions of programs for graphics, so that work is more satisfying. Individual/group help in identifying needed changes. Completion of planning sheets to afford facile changing of programs.

Assignments:

1. All material accomplished thus far is due for review at the end of Week VIII. This includes (1) Notes; (2) Manual sketches and derivations; (3) Printouts of programs with machine sketches attached; (4) Art graphics, matted and unmatted; (5) Research on interdisciplinary applications, notes and references.

2. Complete midterm self-evaluation form and hand in with portfolio.

3. Take a second inventory sheet of computer reactions. Fill out the topical areas in detail. Note changes in attitudes resulting from experience. Write a one-page essay on growth and broadening of attitudes.

4. Have all material up to date, before gaining photography exposure.

Week IX

Lecture:

Connotations of design, and graphic planning of augmented modules. A listing of combinations of development connotated by specific kinds of designs. This is an illustrated lecture, using students' tracings of original modules, accompanied by sorted slides. Example: a highly representational design generally uses varied mirror images, randomizations, serial imagery, rotations, etc. Lesser use of decrementing routines, offsets, radiations of pattern are shown, so as to retain the visual identity of the input pattern. Example two: An abstract pattern that allows for addition and subtraction of the input module has an unlimited number of possibilities, provided the top is different from the bottom, and the right from the left.

Laboratory:

1. Developing the lecture/demonstration, group work is first held in graphic planning of augmented modules. Before, all work was varied by a single design (module) that was manipulated in one way. At times the values were restored, and a second manipulation of the same routine took place. The augmented module is a module that is manipulated, and this enhanced, added-to, augmented module now becomes the design to be manipulated. The augmented modular approach affords many more opportunities for stimulating, professional-looking works.

2. Individual work in graphic planning is accomplished and begun in the laboratory session. (Again see NCC 1977 paper for details.) Students explore many alternatives, tracing the most satisfying augmented modules, and then note the ideas, coordinates, required to accomplish the new module. Example: a long-legged giraffe is mirrored on the X and the Y. The X coordinate is 2.0, and the Y coordinate is 4.2. The mirrored giraffes (four now instead of one) are randomized, serialized, etc. In addition, there are innumerable variations using just the mirror routine with the giraffe design.

3. Introduction to the subroutine augment that affords fairly simple use of the augmented design vs. the single design to achieve new works. Planning sheets introduce the idea, so that people have a chance to begin planning and programming in the lab session, so as to fully understand assignments and new ideas.

4. Open lab period for continuing planning and programming of the augmented module approach.

Assignments:

1. Continue planning outside laboratory sessions of graphic or visual planning to achieve new versions of Designs I and II. Explore in depth pleasing ideas, and sketch these new modules only. If a negative direction is noted, trace one example, and make brief written notes regarding this insight. (A negative reaction is often very helpful in finding positive directions.) Execute at least six

pages of new sketches, using all routines introduced thus far. Have coordinate, parameter notes required to make these changes.

2. Execute and proof one new program using the augmented module approach as a result of sketches and lab work.

Week X

Lecture:

Photography explorations, including photographic manipulation of negatives, Kodaliths, use of a copy camera, Diazos, media combinations. A handout, a paper by the instructor, "The Microfilm Plotter and Computer Art" (see 2) forms the basis for this lecture, with additional ideas experienced since that time, and incorporated into the computer art classes. Actual works, and slides reveal processes used.

Laboratory:

1. Students survey work achieved and make decisions as to their favorite four or five best works to be photographed by the instructor in black and white. Half the works should be simpler modules, and the other half, complex developments of finished graphics. These works will be run in black and white for photography, on industrial paper.

2. Continued work with augmented modules, with review of planning, and sharing of preferred ideas. Analysis should be made whether the new ideas are a continuance of a personal art direction, or if they represent a departure, and to what degree, and how attained.

3. Programming of the augmented modules, with additional individual/group help in this more complex programming undertaking, so that students understand and can independently use this system in future works.

4. Writing assistance on interdisciplinary computer applications is given, based on notes accumulated thus far. Labeling paragraphs with subtitles, rearranging order of material, deleting, adding ideas that appear necessary are accomplished. Use of examples, rather than generalizations is given. Individual and group discussion of principles being used in this research paper. (Note: The course designed for computer science people requires an extensive, highly developed technical paper. This course requires less technical development, but more research into varied applications in the discipline, and it is not as lengthy.)

Assignments:

1. Complete and proof at least one more program using the augmented module approach. (Students now have two such programs.) Each program should be different from the others, and should not utilize the same subroutines.

2. Work on the research paper in depth. Draft one is due at the beginning of Week XIII for laboratory work.

3. If additional writing or programming help is needed, get that help from the instructor so that new work is understandable and executed with a minimum of difficulty. Do not belabor assignments and get "stuck," but rather receive help. If special appointments are required, make them with instructor.

4. Attempt spontaneous, creative approaches in execution of work, as presented during lecture/discussions to see if this approach is efficacious. Note difficulties and facile accomplishments.

Week XI

Lecture:

Guest lecturer on computer poetry, uses of the computer in concordances, stylistic analysis of written material, etc. Readings from computer poetry, by the guest lecturer. Discussion period.

Laboratory:

1. Do a brief experiment in computer poetry, Haiku, assisted by the guest lecturer. Work in laboratory sessions with the instructor to complete the poetry assignment, using BASIC.

2. Open lab period to finish poetry work. Emphasis on personal directon, spontaneity, art as a form of play.

3. Introduction to varied offset routines, including offsets on the X/Y, and a routine that allows offset values to change, along with the scalar value (size) of the component design. Planning sheets facilitate execution of innumerable alternatives before programming. Use of tracing paper mode of visual/graphic planning allows visual perception of the precise offset values to use, and the number required for specific types of images. (See Laboratory session (2), individual work in graphic planning, discussed in Week IX, and in lecture for that week.)

4. Checking photographic slides by instructor of work on 35mm film, with students ironing, preparing their own slides for mounting and use in Week XII. Extra help on material presented so far.

Assignments:

1. Complete poetry programming, and debug for Week XII.

2. Complete planning sheets for offset routines, and program two very different works, departing from previous work accomplished during the semester. Proof and run on industrial paper.

3. Have slides and work ready for photographic session during Week XII.

4. Continue work on research paper.

Week XII

Lecture:

Actual photographic demonstration of: Photographic manipulation of 35 mm positives and negatives, use of a copy camera, reversals, etc. Informal relating of the use of a copy camera in a special laboratory, with instructions on enlargement or decrement of images, along with combinations of materials and images, achieving reversals on photographic paper. Developing, making transparent sheet film (Kodalith) positives and negatives to use in Diazos, silkscreening, etc.

Laboratory:

1. and 2. Manipulation of negatives in a multi-station photo lab. Demonstration and actual experience in manipulating film images of computer art. Note: Half the images were simpler forms, and suitable for fairly active manipulation of multiple-exposure images (5-6); while the more complex negatives can be used in offsets, mirror images, etc. Students work with the negative slide, the positive slide, and the combination of the two in a bas relief form. Solar prints are also demonstrated and attempted. Concept: Computer-aided design can be taken back into varied forms of art, and these forms are particularly effective in photographic graphic arts.

3. Washing and drying prints made during laboratory hours one and two, with informal discussion by the group of specific effects attained by photographic manipulation, not available on cathode ray tubes and plotters. Reference to Herbert Franke's techniques[17] and other possibilities for further explorations.

4. Open mini lab period to complete any work unfinished from previous assignments. Individual and group help.

Assignments:

1. Catch up on any unfinished programming, debug, and run on industrial and/or art papers in finished form.

2. Proofread interdisciplinary graphics/computer applications research papers, and have ready to hand in and discuss during Week XIII.

3. Have Kodalith negatives ready for Diazo demonstration next week.

Week XIII

Lecture:

Informal lecture/demonstration on serigraphy techniques, making a silkscreen, making a direct photo-silkscreen image using Ulano film, developing film, and actual printing of serigraphs, using computer-designed images. Brief history of serigraphy, its uses, types, with demonstrations on making, finishing screens, etc.

Laboratory:

1. In the same silkscreening lab, demonstrate the process making a quick edition of computer-designed prints; showing how a wall hanging is begun and completed (with samples of finished works); screening on plexiglas, and on two sides of Diazo images, etc. While screening, informal relating on types of film and inks (walter-soluble, oil-base systems), etc. Overprinting, underprinting are discussed and viewed as processes demonstrated in art material development (underpainting and overpainting) on the plotter with art papers and colored pens.

2. Return to the mini laboratory, and sharing of ideas from the interdisciplinary research papers. Students are required to make brief notes on cards, and these are permissible to use in a brief oral presentation of ideas and concepts gained from research. Papers are then handed in to instructor at the end of the laboratory sessions, and are used as back-up for questions by their peer group. Note: Too often research is accomplished by the student for himself and the instructor. Much greater learning is attained if varied materials are shared by the group.

3. Continuance of brief oral reports by students on interdisciplinary research.

4. If time permits, have open lab period. If not, use time to complete oral reports by the group. If overlaps occur, and several students have similar topics, have them gather briefly as a panel to summarize the material more broadly.

Assignments:

1. Complete all programming so that finished work is matted or ready to mat for final portfolio.

2. Complete all notes, and have binder ready for review, along with a section of computer printouts, machine sketches, etc.

3. Title all completed art works with personal names. On a card, list routines and materials used. Run an extra printout of the program, to hand in with the graphic, lightly tacked with rubber cement to the back.

Week XIV

Lecture:

Untitled lecture (TBA) on new experiments by instructor. At this time, new work is being undertaken in automated choreography, working with dancers, and filming of the results for a conference. Another project is inputting varied forms of computer art into a synthesized television system and planning music for the resultant film. A history of the project, and descriptive details will accompany the lecture.

Laboratory:

1. Diazochrome demo in an engineering laboratory will show how to develop colored acetate Diazos using Kodaliths and acetate papers, including blueline and brownline papers. Combinations of colors, materials, etc. will be demonstrated, along with finished works.

2. Students work in blueprint room, making Diazos, and combining them with varied Diazo materials, photographic prints, art prints, etc. A supply of inexpensive blue, brownline papers, yellow and blue acetates are available at cost from the instructor, purchased wholesale.

3. Matting unfinished work, with group and individual instruction in finishing graphics, using regular, symmetrical mats or individually planned, irregular mats.

4. If matting is complete, go to open lab period. Generally, the last weeks of each semester are required for matting, plus last-minute help to individual students.

Assignments:

1. Finish matting, and check out a mat-cutter from the department office for overnight use, returning next day, so that others may share materials outside of class.

2. Finish running art graphics, checking for completeness of work.

3. Review notes taken during the semester and bring to next laboratory session for writing assignment, to be begun in class, on viewing the computer.

4. Get any last-minute help needed in any area introduced thus far.

Week XV

Lecture:

Animated films highlight the end of the semester, with generally rented material by noted film-makers, along with brief materials available without cost from Bell Laboratories, etc. Sharing of films with others in the department cuts the cost of film rentals. A brief discussion of ideas presented in the film is given, along with philosophical considerations, ideas by the originator.

Laboratory:

1. Rerunning of films without sound often takes place, to analyze and discuss as a group, techniques of metamorphosis, dominant design changes, etc. (Sometimes films without the sound are run backwards, and are equally effective, accompanied by group discussion.)
2. Matting session, generally required by many in the group. Individual help in finalizing portfolios is given also.
3. Diazo work in engineering lab is generally requested also, to use with industrial paper graphics, photographic papers, etc.
4. Open book essay (beginning of final): viewing the computer, integrating materials introduced during the semester, personal research, attitudinal changes, etc. Students accomplish the listing of main ideas and brief paragraphs or sentences from notes and discussions. This is begun in class, so that the specific parameters of the assignment are understood (allowing for broad personal interpretations), so they may work on the essay before Week XII, finals.

Assignment:

1. Have portfolio and all work ready to hand in and share at finals time.
2. Work on essay assigned, and have this ready to hand in at the end of Week XVI.
3. Get any last-minute help needed, so that all work is handed in, and arrangements are made with instructor to photograph best works. Arrange for pick-up time of art works during Week XVI after finals, before leaving school.

Week XVI

Final Examination:

Generally a two-hour block is reserved for finals. Several activities are emphasized:

1. Sharing of best works, displaying them, enjoying the works of others, discussing material, design development, checking the program on the back, etc.
2. Final self-evaluation form, a definitive self-grading form designed by instructor, along with feedback on the course, with suggestions for changes, together with reasons for change. Brief discussion with the group regarding needed changes in curriculum.
3. Portfolio examination, with a personal interview if desired with instructor to discuss progress, etc.
4. Arrangements for photography and pickup on an overnight basis. Sketches are photographed in black and white, and best finished works in color, by instructor for slide collection.

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